



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

PHOENIX CALIBRATION  
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CALIBRATION

Valid To: January 31, 2025

Certificate Number: 3022.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations<sup>1,7</sup>:

I. Acoustical Quantities

Parameter/Range	Frequency	CMC <sup>2,6</sup> (±)	Comments
Sound Level <sup>3</sup> – Measuring Equipment			
74 dB	(0.125 to 4) kHz	0.32 dB	Sound level calibrator
84 dB	(0.125 to 4) kHz	0.33 dB	
94 dB	(0.125 to 4) kHz	0.33 dB	
104 dB	(0.125 to 4) kHz	0.33 dB	
114 dB	(0.125 to 2) kHz (> 2 to 4) kHz	0.3 dB 0.32 dB	
Acoustical Calibrator <sup>3</sup> –			
(74 to 114) dB	(1 kHz)	0.33 dB	Sound level meter

II. Chemical

Parameter/Equipment	Range	CMC <sup>2, 4, 6</sup> (±)	Comments
<p>Conductivity<sup>3</sup> – Measuring Equipment</p> <p>Fixed Points</p>	<p>(0 to 1) μS/cm                      5 μS/cm +/-10 %                      ≈25 μS/ cm                      ≈50 μS/ cm                      ≈100 μS/cm                      ≈147 μS/ cm                      ≈1000 μS/ cm                      ≈1412 μS/ cm                      ≈10 mS/cm                      ≈100 mS/cm                      ≈150 mS/cm                      ≈200 mS/cm</p>	<p>0.31 μS/cm                      0.31 μS/cm                      0.41 μS/cm                      0.62 μS/cm                      0.83 μS/cm                      2.9 μS/cm                      3.2 μS/cm                      2.2 μS/cm                      32 μS/cm                      290 μS/cm                      600 μS/cm                      600 μS/cm</p>	<p>Conductivity standard solution</p>
<p>Resistivity Simulation</p>	<p>(1 to 100) pS/cm                      (0.001 to 1) μS/cm                      1 μS/cm to 1 mS/cm</p>	<p>0.58 pS/cm + 6 %                      0.15 nS/cm + 0.57 %                      0.62 μS/cm + 0.53 %</p>	<p>Decade box</p>
<p>pH<sup>3</sup> – Measuring Equipment</p> <p>Fixed points</p> <p>pH (mV simulation)</p>	<p>4.00 pH                      7.00 pH                      10.00 pH</p> <p>(4.00 to 10.00) pH</p>	<p>0.017 pH                      0.016 pH                      0.023 pH</p> <p>0.000 63 pH</p>	<p>pH buffer solution</p> <p>Multifunction calibrator</p>
<p>TDS<sup>3</sup> (Total Dissolved Solid) – Measuring Equipment</p>	<p>≈1 mg/L                      ≈3 mg/L                      ≈66 mg/L                      ≈665 mg/L                      ≈940 mg/L                      ≈6650 mg/L                      ≈66 500 mg/L                      ≈100 000 mg/L                      ≈133 000 mg/L</p>	<p>0.2 mg/L                      0.2 mg/L                      0.54 mg/L                      2.3 mg/L                      2.4 mg/L                      22 mg/L                      200 mg/L                      400 mg/L                      400 mg/L</p>	<p>TDS standard solution</p>

### III. Dimensional

Parameter/Equipment	Range	CMC <sup>2, 10</sup> (±)	Comments
Gage Blocks	(0.050 to 4) in (0.5 to 100) mm	(6.2 + 0.86L) μin (0.14 + 0.0021L) μm	Gage blocks & gage block comparator
Cylindrical Gages (Plugs & Pins)	(0.005 to 1) in (0.127 to 25.4) mm	(28 + 0.0021L) μin (0.72 + 0.002L) μm	Laser micrometer & master pin gages
Calipers <sup>3</sup> – Outside, Inside, Step & Depth	Up to 36 in Up to 915 mm	(350 + 0.76L) μin (5.9 + 0.000 13L) μm	Gage blocks
Height Gages	Up to 24 in Up to 500 mm	(610 + 0.76L) μin (15 + 0.048L) μm	Gage blocks
Depth Gage	Up to 24 in Up to 500 mm	(350 + 0.76L) μin (5.9 + 0.000 13L) μm	Gage blocks
Micrometers <sup>3</sup> – Outside, Inside & Depth	Up to 24 in Up to 500 mm	(33 + 4.6L) μin (0.8 + 0.0011L) μm	Gage blocks
Bore Gages	(0.5 to 2) in (12.7 to 50.4) mm	43 μin 0.52 μm	Ring gages
Length Indicators <sup>3</sup>	Up to 8 in Up to 200 mm	(100 + 1.9L) μin (2.6 + 0.000 12L) μm	Gage blocks
Thickness Gages  Dial & Digital, Feeler Gages  Ultrasonic Coating & Thickness Gages	Up to 1 in Up to 25.4 mm  Up to 4 in Up to 100 mm	0.0002 in 5.2 μm  120 μin 1.5 μm	Gage blocks, micrometer  Step block setting standards, gage blocks

Parameter/Equipment	Range	CMC <sup>2, 10</sup> (±)	Comments
Precision Levels – Bubble Levels Electronic Levels	(0 to 15) in (0 to 45) °	30 μin 0.0053°	Surface plate, sine bar, gage blocks
Protractor	(0 to 360) °	0.0053°	Surface plate, sine bar, gage blocks
Surface Plate <sup>3, 5</sup> – Flatness Overall	Up to 161 diagonal in	77 μin + (0.69μin/in · <i>DL</i> )	Electronic level system ( <i>DL</i> = diagonal length in inches)
Rulers & Tapes <sup>3</sup>	(0 to 300) mm (0 to 12) in  (0.05 to 36) in (0 to 1000) mm  (3 to 100) ft (1 to 30.5) m	2.9 μm 120 μin  (190 + 55 <i>L</i> ) μin (13 + 0.021 <i>L</i> ) μm  (0.019 + 0.000 15 <i>L</i> ) in (0.6 + 0.000 15 <i>L</i> ) mm	NIST SOP 10: gauge blocks, measuring microscope  NIST SOP 12: digital ruler calibrator
Microscope <sup>3</sup> – Linearity (X, Y, Z) Angle	(300 x 200 x 200) mm (12 x 8 x 8) in  (0 to 180)°	0.0022 mm 89 μin  0.058°	CEM DI-006-19 gage blocks, length reticle  Angle gage block
Optical Comparator <sup>3</sup> – Linearity (X, Y)	(300 x 200) mm (12 x 8) in	0.0022 mm 92 μin	Gage blocks, length reticle
Sieves – Opening Size Wire Diameter	(0.020 to 125) mm (0.0008 to 5) in  (0.020 to 125) mm (0.0008 to 5) in	(2.1 + 0.94 <i>D</i> ) um (81 + 1 <i>D</i> ) μin  15 μm 620 μin	ASTM E11: measuring microscope  Caliper

IV. Dimensional Testing<sup>9</sup>

Parameter/Equipment	Range	CMC <sup>2, 6, 10</sup> (±)	Comments
Luer Conical Fittings – Diameter & Length	Up to 50 mm	(2.9 + 0.8L) μm	ISO 594/1 & ISO 594/2: measuring microscope
1D Dimensional Measurement –  Length X,Y	Up to 11.5 in Up to 290 mm	(120 + 1.4L) μin (2.9 + 0.016L) μm	Measuring microscope
	(11.5 to 24) in (290 to 600) mm	1600 μin 0.037 mm	Digital caliper
Z	Up to 11.5 in Up to 290 mm	(240 + 0.74L) μin (2.9 + 0.016L) μm	Measuring microscope
	(11.5 to 24) in (290 to 600) mm	0.0016 in 0.037 mm	Digital caliper
Radius	(0 to 20) mm	1.7 μm	Measuring microscope with laser scale
	Up to 11.5 in Up to 290 mm	(120 + 1.4L) μin (2.9 + 0.016L) μm	Measuring microscope
Angle	11.5 to 24 in (290 to 600) mm	0.0018 in 0.037 mm	Digital caliper
	(0 to 180)°	0.087°	Measuring microscope

V. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC <sup>2, 5</sup> (±)	Comments
DC Current <sup>3</sup> – Generate	(0 to 220) μA (0.22 to 2.2) mA (2.2 to 22) mA (22 to 220) mA 220 mA to 2.2 A	7.7 nA + 23 μA/A 36 nA + 37 μA/A 190 nA + 34 μA/A 4.1 μA + 53 μA/A 32 μA + 79 μA/A	Multifunction calibrator

Parameter/Equipment	Range	CMC <sup>2,5</sup> (±)	Comments
DC Current <sup>3</sup> – Generate (cont)	(2.2 to 11) A	53 µA + 860 µA/A	Multifunction calibrator with transconductance amplifier
	(11 to 30) A	2 mA + 1.1 mA/A	Multifunction calibrator
Clamp-On Ammeters Toroidal <sup>3</sup>	(0 to 1500) A	(130 mA + 2.8 mA/A)	Multifunction calibrator with 50-coils
DC Current <sup>3</sup> – Measure	(0 to 100) µA (0.1 to 1) mA (1 to 10) mA (10 to 100) mA	4.5 nA + 7.3 µA/A 42 nA + 7.8 µA/A 200 nA + 12 µA/A 960 nA + 46 µA/A	8.5-digit digital multimeter
	(0.1 to 1) A (1 to 10) A (10 to 30) A (30 to 1000) A	300 µA + 150 µA/A 720 µA + 420 µA/A 5.4 mA + 500 µA/A 2.5 mA + 5.1 mA/A	8.5-digit digital multimeter with shunt
DC Voltage <sup>3</sup> – Generate	(0 to 0.22) V (0.22 to 2.2) V (2.2 to 22) V (22 to 220) V (220 to 1100) V	1.2 µV + 4.8 µV/V 2.3 µV + 6.3 µV/V 14 µV + 4.5 µV/V 520 µV + 7.5 µV/V 1.2 mV + 6.5 µV/V	Multifunction calibrator
	(1.1 to 10) kV	38 V + 29 mV/V	Hipot with HV probe
DC Voltage <sup>3</sup> – Measure	(0 to 0.1) V (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 1000) V	1.8 µV + 3.9 µV/V 3.1 µV + 3.5 µV/V 32 µV + 3.8 µV/V 480 µV + 5.7 µV/V 3.3 mV + 5.7 µV/V	Precision multimeter
DC Voltage <sup>3</sup> – Measure	(Up to 100) kV	2.7 V + 0.61 %	High-accuracy kilovolt meter
AC Voltage <sup>3</sup> – Measure	(0 to 70) kV	2.2 V + 1.5 %	High-accuracy kilovolt meter



Parameter/Equipment	Range	CMC <sup>2,5</sup> (±)	Comments
Resistance <sup>3</sup> – Measure (cont)	(1 to 10) kΩ (10 to 100) kΩ (100 to 1000) kΩ (1 to 10) MΩ (10 to 100) MΩ (100 to 1000) MΩ (1 to 100) GΩ (100 to 1000) GΩ	28 mΩ + 11 μΩ/Ω 1.2 Ω + 6.6 μΩ/Ω 170 Ω + 2.1 μΩ/Ω 150 Ω + 11 μΩ/Ω 0.58 MΩ + 20 μΩ/Ω 5.8 MΩ + 370 μΩ/Ω 0.84 GΩ + 1.9 % 8 GΩ + 2 %	Precision multimeter, resistance box

Parameter/Range	Frequency	CMC <sup>2,5</sup> (±)	Comments
Resistance <sup>3</sup> – Measure  (0 to 10) Ω (10 to 100) Ω (100 to 1000) Ω (1 to 10) kΩ	1 kHz	5.9 mΩ + 740 μΩ/Ω 5.9 mΩ + 1 mΩ/Ω 5.9 mΩ + 1.1 mΩ/Ω 0.48 Ω + 0.92 mΩ/Ω	Precision LCR meter
Resistance <sup>3</sup> – Generate  (0 to 10) Ω (10 to 100) Ω (100 to 1000) Ω (1 to 10) kΩ (10 to 100) kΩ (100 to 1000) kΩ (1 to 10) MΩ	1 kHz	29 mΩ + 180 μΩ/Ω 29 mΩ + 790 μΩ/Ω 35 mΩ + 0.1 % 190 mΩ + 0.11 % 3.2 Ω + 0.13 % 0.15 kΩ + 0.11 % 19 kΩ + 0.054 %	Resistance box
Capacitance <sup>3</sup> – Measure  (0 to 10) pF (10 to 100) pF (0.1 to 1) nF (1 to 10) nF (10 to 100) nF (0.10 to 1) μF (1 to 10) μF (10 to 100) μF (100 to 1000) μF	1 kHz	0.0025 pF + 2.7 % 0.059 pF + 3.8 mF/F 59 pF + 28 μF/F 190 pF + 78 μF/F 67 pF + 570 μF/F 700 pF + 990 μF/F 8.1 nF + 1.7 mF/F 220 nF + 1.7 mF/F 1.2 nF + 1.7 %	Precision LCR meter



Parameter/Range	Frequency	CMC <sup>2,5</sup> (±)	Comments
Capacitance – Generate  Fixed Points <sup>3</sup>  100 pF 1 nF 10 nF 100 nF 1 μF 10 μF 100 μF 1 mF 10 mF  1 μF 10 μF 100 μF 1 mF 10 mF 100 mF	1 kHz           100 Hz, 120 Hz	1.6 pF 4.6 pF 38 pF 0.38 nF 3.8 nF 34 nF 0.34 μF 1.9 μF 0.16 mF  2.9 nF 32 nF 320 nF 3.6 μF 110 μF 1.1 mF	Standard capacitors
Capacitance <sup>3</sup> – Generate  (10 to 100) nF (100 to 1000) nF (1 to 10) μF (10 to 100) μF	1 kHz	98 pF + 0.12 % 0.24 nF + 0.18 % 16 nF + 0.46 % 120 nF + 0.49 %	Decade capacitance box
Inductance <sup>3</sup> – Measure  (1 to 100) μH (0.1 to 100) mH (0.1 to 1) H	(100 & 1) kHz	12 nH + 0.36 % 0.42 μH + 0.12 % 41 μH + 0.091 %	Precision LCR meter
Inductance <sup>3</sup> – Generate  (1 to 100) μH (0.1 to 100) mH (0.1 to 1) H	1 kHz	25 nH + 2.6 % 3 μH + 2.8 % 12 μH + 2.4 %	Inductor decade box

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Electrical Simulation of Thermocouple Temperature Indicators <sup>3</sup> –			
Type B	(600 to 800) °C (800 to 1000) °C (1000 to 1550) °C (1550 to 1820) °C	0.54 °C 0.40 °C 0.38 °C 0.39 °C	Temperature simulator in sourcing mode
Type C	(0 to 150) °C (150 to 650) °C (650 to 1000) °C (1000 to 1800) °C (1800 to 2316) °C	0.35 °C 0.30 °C 0.36 °C 0.58 °C 0.97 °C	
Type E	(-250 to -100) °C (-100 to -25) °C (-25 to 350) °C (350 to 650) °C (650 to 1000) °C	0.23 °C 0.19 °C 0.16 °C 0.16 °C 0.19 °C	
Type J	(-210 to -100) °C (-100 to -30) °C (-30 to 150) °C (150 to 760) °C (760 to 1200) °C	0.26 °C 0.19 °C 0.17 °C 0.17 °C 0.19 °C	
Type K	(-270 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 1000) °C (1000 to 1372) °C	0.31 °C 0.21 °C 0.19 °C 0.30 °C 0.46 °C	
Type L	(-200 to -100) °C (-100 to 800) °C (800 to 900) °C	0.43 °C 0.30 °C 0.20 °C	
Type N	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 410) °C (410 to 1300) °C	0.47 °C 0.27 °C 0.23 °C 0.22 °C 0.32 °C	
Type R	(0 to 250) °C (250 to 400) °C (400 to 1000) °C (1000 to 1750) °C	0.68 °C 0.41 °C 0.39 °C 0.47 °C	

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments	
Electrical Simulation of Thermocouple Temperature Indicators <sup>3</sup> – (cont)				
Type S	(0 to 250) °C (250 to 1000) °C (1000 to 1400) °C (1400 to 1750) °C	0.54 °C 0.45 °C 0.43 °C 0.54 °C	Temperature simulator in sourcing mode	
Type T	(-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C	0.73 °C 0.28 °C 0.19 °C 0.17 °C		
Type U	(-200 to 0) °C (0 to 600) °C	0.65 °C 0.31 °C		
Electrical Simulation of Thermocouple Simulators <sup>3</sup> –				
Type B	(600 to 800) °C (800 to 1000) °C (1000 to 1550) °C (1550 to 1820) °C	0.57 °C 0.45 °C 0.39 °C 0.41 °C		Temperature simulation meter in measuring mode
Type C	(0 to 150) °C (150 to 650) °C (650 to 1000) °C (1000 to 1800) °C (1800 to 2316) °C	0.37 °C 0.32 °C 0.38 °C 0.60 °C 1.00 °C		
Type E	(-250 to -100) °C (-100 to -25) °C (-25 to 350) °C (350 to 650) °C (650 to 1000) °C	0.58 °C 0.19 °C 0.16 °C 0.19 °C 0.24 °C		
Type J	(-210 to -100) °C (-100 to -30) °C (-30 to 150) °C (150 to 760) °C (760 to 1200) °C	0.32 °C 0.19 °C 0.17 °C 0.20 °C 0.19 °C		

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Electrical Simulation of Thermocouple Simulators <sup>3</sup> – (cont)			
Type K	(-270 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 1000) °C (1000 to 1372) °C	0.39 °C 0.22 °C 0.19 °C 0.31 °C 0.47 °C	Temperature simulation meter in measuring mode
Type L	(-200 to -100) °C (-100 to 800) °C (800 to 900) °C	0.43 °C 0.30 °C 0.20 °C	
Type N	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 410) °C (410 to 1300) °C	0.47 °C 0.27 °C 0.23 °C 0.22 °C 0.32 °C	
Type R	(0 to 250) °C (250 to 400) °C (400 to 1000) °C (1000 to 1767) °C	0.69 °C 0.45 °C 0.41 °C 0.49 °C	
Type S	(-25 to 250) °C (250 to 1000) °C (1000 to 1400) °C (1400 to 1767) °C	0.59 °C 0.45 °C 0.46 °C 0.57 °C	
Type T	(-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C	0.73 °C 0.28 °C 0.22 °C 0.17 °C	
Type U	(-200 to 0) °C (0 to 600) °C	0.65 °C 0.31 °C	
Electrical Simulation of RTD Temperature Simulators <sup>3</sup> –			
PT100 (385)	(-200 to -80) °C (-80 to 0) °C (0 to 100) °C	0.022 °C 0.044 °C 0.041 °C	

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Electrical Simulation of RTD Temperature Simulators <sup>3</sup> – (cont)			
PT100 (385)	(100 to 300) °C (300 to 400) °C (400 to 630) °C (630 to 800) °C	0.043 °C 0.045 °C 0.048 °C 0.052 °C	Temperature simulation meter in measuring mode
PT100 (3926)	(-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C	0.0045 °C 0.0047 °C 0.022 °C 0.040 °C 0.044 °C 0.048 °C	
PT100 (3916)	(-200 to -190) °C (-190 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C	0.0045 °C 0.0053 °C 0.0047 °C 0.039 °C 0.042 °C 0.042 °C 0.044 °C 0.047 °C 0.047 °C	
PT200 (385)	(-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 630) °C	0.011 °C 0.011 °C 0.040 °C 0.040 °C 0.019 °C 0.022 °C 0.027 °C	
PT500 (385)	(-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 630) °C	0.0083 °C 0.0086 °C 0.0088 °C 0.0095 °C 0.025 °C 0.026 °C 0.027 °C	
PT1000 (385)	(-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C	0.0043 °C 0.020 °C 0.021 °C 0.020 °C 0.022 °C	

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Electrical Simulation of RTD Temperature Simulators <sup>3</sup> – (cont)			
PT1000 (385)	(300 to 400) °C (400 to 630) °C	0.023 °C 0.024 °C	Temperature simulation meter in measuring mode
PtNi (385), 120Ω	(-80 to 0) °C (0 to 100) °C (100 to 260) °C	0.025 °C 0.019 °C 0.015 °C	
Cu 427, 10Ω	(-100 to 260) °C	0.084 °C	
YS1400	(15 to 50) °C	0.0099 °C	
25 Ω SPRT3	(-200 to 660) °C	0.019 °C	
Electrical Simulation of RTD Indicators <sup>3</sup> –			
PT100 (385)	(-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 630) °C (630 to 800) °C	0.014 °C 0.014 °C 0.022 °C 0.035 °C 0.10 °C	Temperature simulator in source mode
PT100 (3926)	(-200 to 0) °C (0 to 300) °C (300 to 630) °C	0.013 °C 0.034 °C 0.12 °C	
PT100 (3916)	(-200 to -190) °C (-190 to 300) °C (300 to 630) °C	0.032 °C 0.03 °C 0.032 °C	
PT200 (385)	(-200 to 260) °C (260 to 400) °C (400 to 630) °C	0.032 °C 0.10 °C 0.11 °C	
PT500 (385)	(-200 to -80) °C (-80 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C	0.033 °C 0.098 °C 0.097 °C 0.21 °C 0.22 °C	
PT1000 (385)	(-200 to -80) °C (-80 to 260) °C (260 to 630) °C	0.098 °C 0.32 °C 0.37 °C	

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Electrical Simulation of RTD Indicators <sup>3</sup> – (cont)			
PtNi 385, 120Ω (Ni120)	(-80 to 0) °C (0 to 100) °C (100 to 260) °C	0.013 °C 0.02 °C 0.058 °C	Temperature simulator in source mode
Cu 427, 10 Ω	(-100 to 260) °C	0.88 °C	
YS1400	(15 to 50) °C	0.0099 °C	

Parameter/Range	Frequency	CMC <sup>2,5</sup> (±)	Comments
AC Current <sup>3</sup> – Generate			
(0 to 20) μA	(0.1 to 1) kHz (1 to 10) kHz	12 nA + 17 μA/A 75 nA + 210 μA/A	Multifunction calibrator
(20 to 220) μA	(0.04 to 1) kHz (1 to 5) kHz (5 to 10) kHz	13 nA + 92 μA/A 22 nA + 240 μA/A 84 nA + 940 μA/A	
(0.22 to 2.2) mA	40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	76 nA + 110 μA/A 180 nA + 160 μA/A 840 nA + 940 μA/A	
(2.2 to 22) mA	40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	770 nA + 110 μA/A 1.7 μA + 170 μA/A 8.1 μA + 950 μA/A	
(22 to 220) mA	(0.04 to 1) kHz (1 to 5) kHz (5 to 10) kHz	7.4 μA + 110 μA/A 17 μA + 170 μA/A 58 μA + 1 mA/A	
(0.22 to 2.2) A	(0.04 to 1) kHz (1 to 5) kHz (5 to 10) kHz	130 μA + 260 μA/A 280 μA + 410 μA/A 0.97 mA + 7.7 mA/A	
(2.2 to 11) A	(0.04 to 1) kHz (1 to 5) kHz (5 to 10) kHz	2.7 mA + 930 μA/A 1 mA + 1 mA/A 1.6 mA + 4 mA/A	

Parameter/Range	Frequency	CMC <sup>2,5</sup> (±)	Comments
AC Current <sup>3</sup> – Generate (cont)			
(11 to 20) A	(0.040 to 1) kHz	7.5 mA + 1.4 mA/A	Multifunction calibrator with transconductance amplifier
(20 to 30) A	(0.040 to 1) kHz	12 mA + 710 µA/A	Advance Calibrator 4015
AC Current <sup>3</sup> – Measure			
(0 to 100) µA	40 Hz to 1 kHz	38 nA + 410 µA/A	8.5-digit digital multimeter
(0.1 to 1) mA	40 Hz to 1 kHz	190 nA + 420 µA/A	
(1 to 10) mA	40 Hz to 1 kHz	1.9 µA + 420 µA/A	
(10 to 100) mA	40 Hz to 1 kHz	21 µA + 410 µA/A	
(0.1 to 1.05) A	40 Hz to 1 kHz	230 µA + 610 µA/A	
(1.05 to 10) A	(0.04 to 1) kHz	4 mA + 1 mA/A	
(10 to 30) A	(0.04 to 1) kHz	12 mA + 1 mA/A	
AC Voltage <sup>3</sup> – Generate			
(0 to 2.2) mV	(0.04 to 1) kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (500 to 1000) kHz	4.7 µV + 2 µV/V 4.7 µV + 2 µV/V 4.8 µV + 12 µV/V 5.9 µV + 62 µV/V 12 µV + 130 µV/V 24 µV + 120 µV/V 25 µV + 420 µV/V	Multifunction calibrator
(2.2 to 22) mV	(0.04 to 1) kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (500 to 1000) kHz	4.8 µV + 19 µV/V 4.8 µV + 19 µV/V 5.5 µV + 90 µV/V 6.5 µV + 350 µV/V 13 µV + 760 µV/V 26 µV + 820 µV/V 26 µV + 2.2 mV/V	



Parameter/Range	Frequency	CMC <sup>2,5</sup> (±)	Comments
AC Voltage <sup>3</sup> – Generate (cont)			
(22 to 220) mV	(0.04 to 1) kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (500 to 1000) kHz	9 μV + 60 μV/V 9 μV + 60 μV/V 13 μV + 180 μV/V 22 μV + 440 μV/V 30 μV + 910 μV/V 67 μV + 1.3 mV/V 79 μV + 2.8 mV/V	Multifunction calibrator
(0.22 to 0.5) V	(0.04 to 1) kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (500 to 1000) kHz	25 μV + 29 μV/V 26 μV + 30 μV/V 30 μV + 49 μV/V 44 μV + 67 μV/V 100 μV + 320 μV/V 260 μV + 750 μV/V 360 μV + 1.4 mV/V	
(0.5 to 1) V	(0.04 to 1) kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (500 to 1000) kHz	26 μV + 40 μV/V 26 μV + 41 μV/V 30 μV + 66 μV/V 44 μV + 92 μV/V 100 μV + 390 μV/V 0.34 mV + 860 μV/V 0.43 mV + 1.6 mV/V	
(1 to 2) V	(0.04 to 1) kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (500 to 1000) kHz	300 μV + 23 μV/V 300 μV + 23 μV/V 160 μV + 68 μV/V 310 μV + 110 μV/V 280 μV + 480 μV/V 580 μV + 900 μV/V 0.64 mV + 1.7 mV/V	
(2 to 22) V	(0.04 to 1) kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (500 to 1000) kHz	300 μV + 44 μV/V 300 μV + 44 μV/V 460 μV + 69 μV/V 500 μV + 96 μV/V 1.4 mV + 260 μV/V 6.8 mV + 890 μV/V 7.4 mV + 1.4 mV/V	
(22 to 220) V	(0.04 to 1) kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	3 mV + 48 μV/V 4.1 mV + 49 μV/V 6.8 mV + 67 μV/V 7.3 mV + 140 μV/V	
(220 to 1100) V	(0.05 to 1) kHz	27 mV + 66 μV/V	

Parameter/Range	Frequency	CMC <sup>2,5</sup> (±)	Comments
AC Voltage <sup>3</sup> – Generate (cont)			
(0 to 300) V	(0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz	9.8 mV + 160 μV/V 22 mV + 620 μV/V 62 mV + 2.5 mV/V	Multifunction calibrator with transconductance amplifier
(300 to 600) V	(0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz	14 mV + 170 μV/V 38 mV + 630 μV/V 84 mV + 2.5 mV/V	
(600 to 1000) V	(0.04 to 20) kHz (20 to 30) kHz	21 mV + 170 μV/V 33 mV + 660 μV/V	
(1.1 to 10) kV	60 Hz	25 V + 60 mV/V	Hipot with HV probe
AC Voltage <sup>3</sup> – Measure			
(0 to 100) mV	10 Hz to 1 kHz (1 to 20) kHz (20 to 100) kHz	23 μV + 190 μV/V 24 μV + 280 μV/V 0.12 mV + 390 μV/V	8.5-digit digital multimeter
(0.1 to 1) V	10 Hz to 1 kHz (1 to 20) kHz (20 to 100) kHz (100 to 1) MHz	93 μV + 160 μV/V 130 μV + 350 μV/V 610 μV + 600 μV/V 29 mV + 5.1 mV/V	
(1 to 10) V	(0.01 to 1) kHz (1 to 20) kHz (20 to 100) kHz 100 kHz to 200 kHz	0.93 mV + 160 μV/V 1.3 mV + 350 μV/V 6.1 mV + 600 μV/V 0.29 V + 5.1 mV/V	
10 to 100) V	10 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz	9.2 mV + 160 μV/V 13 mV + 460 μV/V 24 mV + 230 μV/V	
(100 to 1000) V	10 Hz to 1 kHz (1 to 10) kHz	96 mV + 260 μV/V 75 mV + 510 μV/V	
AC Power <sup>3</sup> – Generate			
(0.1089 to 2.97) mW (0.297 to 10.89) mW (1.089 to 29.7) mW (2.97 to 108.9) mW (10.89 to 297) mW (29.7 to 726) mW	(45 to 65) Hz PF =1	0.0017 mW + 0.2 % 0.015 mW + 0.084 % 0.017 mW + 0.12 % 0.017 mW + 0.11 % 0.17 mW + 0.11 % 0.17 mW + 0.11 %	Fluke 5522A

Parameter/Range	Frequency	CMC <sup>2,5</sup> (±)	Comments
AC Power <sup>3</sup> – Generate (cont)			
72.6 mW to 1.49 W	(45 to 65) Hz	0.14 %	Fluke 5522A
149 mW to 6.76 W	PF =1	0.12 %	
1.09 mW to 9.18 W		0.13 %	
2.97 mW to 33.6 W		0.083 %	
10.9 mW to 91.8 W		0.13 %	
29.7 mW to 337 W		0.083 %	
109 mW to 918 W		0.12 %	
297 mW to 2244 W		0.094 %	
72.6 mW to 4.59 kW		0.13 %	
1.49 W to 20.91 Kw		0.11 %	
Clamp-On Meters			
0.0209 kW to 1 MW	(45 to 65) Hz PF =1	0.95 %	Fluke 5522A & Fluke 5500 with 50 turns coil
Phase <sup>3</sup> – Generate	(10 to 65) Hz (65 to 500) Hz (0.5 to 1.0) kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) Hz	0.13° 0.3° 0.58° 2.9° 5.8° 12°	Fluke 5522A
AC Current <sup>3</sup> – Generate, Clamp-On Ammeters Toroidal			
(0 to 1500) A	(30 to 60) Hz	130 mA + 2.8 mA/A	Multifunction calibrator with 50-coils

Parameter/Equipment	Range	CMC <sup>2,5</sup> (±)	Comments
AC Current <sup>3</sup> – Measure, Clamp-On Ammeters Toroidal	(0 to 1000) A	0.14 A + 2.9 mA/A	Current clamp

Parameter/Equipment	Range	CMC <sup>2,5</sup> (±)	Comments	
Oscilloscopes <sup>3</sup> –				
Amplitude – DC				
50 Ω	(-6.6 to 6.6) V	47 μV + 0.31 %	Multifunction calibrator with oscilloscope calibration option	
1 MΩ	(-130 to 130) V	0.3 mV + 0.06 %		
Amplitude – Square Wave				
50 Ω	Up to 6.6 Vpp	46 μV + 0.29 %		
1 MΩ	Up to 130 Vpp	61 μV + 0.12 %		
Leveled Sine Wave (Flatness ref. 50 kHz) [5 mV to 5.5 V]				
	50 kHz to 100 MHz	120 μV + 2.2 %		
	(100 to 300) MHz	120 μV + 2.9 %		
	(300 to 600) MHz	120 μV + 4.9 %		
Amplitude – Leveled Sine Wave				
50 Ω	50 kHz Reference [5 mV to 5.5 V]	400 μV + 2.6 %		
Leveled Sine Wave – Frequency				
50 Ω	(0.05 to 600) MHz	330 mHz + 8.2 μHz/Hz		
Time Marker Function				
50 Ω	5 s to 50 ms	0.9 ns + 0.65 %		
	20 ms to 100 ns	0.058 ps + 0.000 31 %		
	(20 to 50) ns	0.083 fs + 0.000 31 %		
	10 ns	0.58 fs + 0.000 3 %		
	(2 to 5) ns	0.065 fs + 0.000 31 %		
Edge – Rise Time				
(1 to 10) MHz	≤ 300 ps	23 ps		
Pulse Width –				
10 mV to 2.5 V	(4 to 500) ns	2.4 ns + 11 %		
Welders <sup>3</sup> –				
DC Volt	Up to 500 V	30 mV + 290 μV/V	IEC 60974-14:2018 DMM, clamp meter, load bank	
DC Amps	Up to 1000 A	0.63 A + 1.8 mA/A		
AC Volt	Up to 500 V	0.29 V + 2.9 mV/V		
AC Amps	Up to 1000A	0.33 A + 2.8 mA/A		

VI. Fluid Quantities

Parameter/Equipment	Range	CMC <sup>2, 4, 6</sup> (±)	Comments
Volumetric Flow <sup>3,11</sup> – Gas (Air) – Measuring Equipment			
Standard Conditions (Nominal) at 101.3 kPa & 21 °C	(1 to 100) cm <sup>3</sup> /min	0.054 cm <sup>3</sup> /min + 1.2 %	Air flow bubble flowmeter
	(100 to 250) cm <sup>3</sup> /min	0.098 cm <sup>3</sup> /min + 1.2 %	
	(250 to 30 000) cm <sup>3</sup> /min	0.15 cm <sup>3</sup> /min + 1.2 %	Air flowmeter
	(0.02 to 6) L/min (6 to 30) L/min	2.6 mL/min + 1.2 % 15 mL/min + 1.3 %	Air flow bubble flowmeter
Standard Conditions (Air & Nitrogen)	(0 to 300) L/min	15 mL/min + 2.3 %	Mass flow meter
	(100 to 650) ft <sup>3</sup> /min	9.2 ft <sup>3</sup> /min + 4.1 %	Anemometer
Volumetric Flow <sup>3</sup> – Liquid – Measuring Equipment			
	(0 to 1000) mL/min	8.5 µL/min + 0.03 %	Weight standards with timer
	(1 to 20) L/min	18 mL/min + 0.42 %	
	(0 to 600) L/min	66 mL/min + 0.44 %	
	Up to 3200 L/min	4.1 mL/min + 2.1%	Ultrasonic flow meter
	(5 to 1000) L/min	1.1 mL/min + 0.19 %	Coriolis mass flow meter
Volumetric Flow <sup>3</sup> – Liquid – Measuring Equipment	(20 to 650) L	30 mL + 0.45 %	Gravimetric method: NIST SOP14
Volume Totalizers	From 50 L	23 ml + 0.25 %	Coriolis mass flow meter
Piston-Operated Volumetric Apparatus <sup>3</sup> – Pipettes, Burettes, Dispensers, Repeaters & Syringes – Measuring Equipment			
	(> 1 to 10) µL	0.027 µL	Gravimetric method: ISO 8655-6:2022
	(> 10 to 100) µL	0.16 µL	
	(> 100 to 1000) µL	1.1 µL	
	(> 1000 to 10 000) µL	11 µL	
	(> 10 to 20) mL	21 µL	
	(> 20 to 100) ml (> 100 to 200) ml	53 µL 64 µL	

Parameter/Equipment	Range	CMC <sup>2,4</sup> (±)	Comments
Piston-Operated Volumetric Apparatus <sup>3</sup> – Pipettes, Burettes, Dispensers, Repeaters & Syringes – Measuring Equipment	(> 10 to 100) µL (> 0.1 to 1) mL (> 1 to 10) mL (> 10 to 100) mL	0.56 µL 4.4 µL 5.3 µL 19 µL	Gravimetric method:  NIST SOP 14
Volumetric Ware – (To Contain or To Deliver)	(0.1 to 1) ml (>1 to 10) ml (>10 to 100) ml (>0.1 to 1) L (>1 to 10) L (>10 to 100) L (100 to 600) L  (100 to 75 000) L	4.4 µL 4.9 µL 22 µL 0.1 mL 5.5 mL 12 mL 71 mL  41 L + 3.3 mL/L	NIST SOP 14 - gravimetric method        Euramet guide 21
Specific Gravity <sup>3</sup> (Relative Density & Other Related Conversions) – Hydrometers	(0.60 to 1.00) SG (1.00 to 1.36) SG (1.36 to 1.92) SG	0.000 91 SG 0.0015 SG 0.0015 SG	ASTM E126
Turbidity <sup>3</sup> –  Turbidity Meter	0.5 NTU 10 NTU 20 NTU 100 NTU 500 NTU 1000 NTU 4000 NTU	0.038 NTU 0.21 NTU 0.28 NTU 1.6 NTU 5.4 NTU 17 NTU 79 NTU	Certified reference materials – turbidity
Viscosity <sup>3</sup> –  Viscosity Meter	(3.9 to 5.4) cP (34.03 to 43.25) cP (64.7 to 84.75) cP  (119.4 to 161.1) cP (81.03 to 271.4) cP (251.2 to 776.3) cP	0.0029 cP + 0.24 % 0.035 cP + 0.55 % 0.067 cP + 0.62 %  0.61 cP + 0.41% 0.14 cP + 0.68 % 0.61 cP + 0.75 %	ASTM D341: Standard reference solutions  Temperature (20 to 40) °C

Parameter/Equipment	Range	CMC <sup>2,4</sup> (±)	Comments
Viscosity <sup>3</sup> – (cont)			ASTM D341: Standard reference solutions
Viscosity Meter	(384.2 to 561.2) cP (2386 to 10 420) cP (3433 to 19 000) cP (6527 to 36 070) cP (10 120 to 55 970) cP (13 160 to 73 280) cP (17 860 to 99 140) cP	0.61 cP + 0.33 % 4.9 cP + 0.99 % 8.1 cP + 1.1 % 15 cP + 1.2 % 24 cP 1.2 % 30 cP + 1.2 % 40 cP + 1.8 %	Temperature (20 to 40) °C
Viscosity Cup <sup>3</sup> – ASTM/Ford, Zahn, Shell	(5 to 587) cST at 25 °C	1.4 cST + 0.17 %	Viscosity standard solutions, timer

## VII. Mechanical

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Durometer <sup>3</sup> – (Types: A, B, C, D, DO, E, M, O, OO, OOO, OOO-S, R)			ASTM D2240: DP = Duro point
Spring Calibration Force			
(M,OO,OOO,OOO-S)	(0 to 100) DP (Up to 197) gf	0.08 DP 0.075 gf	Standard weights
(C,D,DO)	(0 to 100) DP (Up to 4533) gf	0.08 DP 3.7 gf	
(A,B,E,O)	(0 to 100) DP (Up to 816) gf	0.08 DP 0.61 gf	
Indenter Extension & Shape –			
Diameter	Up to 0.5 in	75µin	Measuring microscope
Radius	Up to 0.5 in	75µin	
Angle	(20 to 45)°	0.25°	
Extension	Up to 0.5 in	75 µin	
Indenter Display	Up to 0.2 in	100 µin + 0.05 µin/in	Gage blocks

Parameter/Equipment	Range	CMC <sup>2, 4, 6</sup> ( $\pm$ )	Comments
Indirect Verification of Rockwell Hardness Testers <sup>3</sup>	HRC: Low Medium High  HRBW: Low Medium High  HR30N: Low Medium High	0.95 HRC 0.67 HRC 0.62 HRC  1.3 HRBW 1.2 HRBW 1.2 HRBW  1.3 HR30N 0.91 HR30N 0.73 HR30N	ASTM E18
Balances & Scales <sup>3</sup> –	(0.001 to 5) g (5 to 20) g (20 to 200) g (200 to 1000) g (1000 to 5000) g (5 to 30) kg (30 to 65 kg) (65 to 600) kg (600 to 5000) kg (5000 to 15 000) kg  (15 000 to 60 000) kg  (0 to 100 000) kg	3.5 $\mu$ g + 0.33 $\mu$ g/g 7 $\mu$ g + 0.36 $\mu$ g/g 51 $\mu$ g + 0.13 $\mu$ g/g 0.16 mg + 0.52 $\mu$ g/g 5.5 mg + 0.14 $\mu$ g/g 18 mg + 2.3 $\mu$ g/g 100 mg + 0.71 $\mu$ g/g 5.5 g + 2.8 g / 25 kg 54 g + 2.8 g / 25 kg 1.1 kg + 33 g / 500 kg  5.8 kg + 7.5 kg / 15 000 kg  9 kg + 0.058 g/kg	Standards weights        Standard weights & substitution method  Electrical simulation for capacities exceeding 60 000 kg, process meter
Speed Indicators Rotational Velocity, Rotational Devices, Centrifuges, Shakers, Stirrers, Tachometers, Etc. <sup>3</sup> –  Contact	(5 to 1000) rpm (1000 to 10 000) rpm (10 000 to 100 000) rpm (100 000 to 500 000) rpm	0.29 rpm + 0.000 64 % 0.59 rpm + 0.0026 % 1.2 rpm + 0.0057 % 2 rpm + 0.0058 %	Standard tachometer



Parameter/Equipment	Range	CMC <sup>2, 4, 6</sup> ( $\pm$ )	Comments
Speed Indicators Rotational Velocity, Rotational Devices, Centrifuges, Shakers, Stirrers, Tachometers, Etc. <sup>3</sup> – (cont)			
Non-Contact (Optical)	(0 to 9 000) rpm (9 000 to 100 000) rpm (100 000 to 500 000) rpm	0.029 rpm + 0.002 % 0.12 rpm + 0.0024 % 1 rpm + 0.0021 %	Standard stroboscope
Speed – Measure	(Up to 50) in/min  (2 to 78 000) in/min	0.07 %  1.6 in/min + 0.68 %	Ruler & stopwatch  Contact tachometer with 10 cm wheel
Moisture Analyzers (Lost Weight Method)	(0 to 15) %	0.092 %	Analytical balance & convection furnace
Nuclear Surface Moisture & Density Gauge <sup>3, 8</sup> –			
Density	(1786 to 2600) kg/m <sup>3</sup>	0.61 %	ASTM D7759
Moisture	(32.9 to 37.8) %	1.3 %	
Air Velocity – Measuring Equipment	(0 to 40) m/s	0.0082 m/s + 1.7 %	IEC 61400 Annex F Standard anemometer
Torque Analyzers/ Testers <sup>3</sup>	Up to 2.5 lbf·in (2.5 to 25) lbf·in (25 to 250) lbf·in (250 to 15 000) lbf·in	0.011 lbf·in + 0.014 % 0.015 lbf·in + 0.068 % 0.15 lbf·in + 0.068 % 1.2 lbf·in + 0.11 %	ASTM E2624-17: torque arms, torque wheels & standards weights

Parameter/Equipment	Range	CMC <sup>2, 4, 6, 10, 11</sup> (±)	Comments
Torque Tools <sup>3</sup>	Up to 44 lbf·in (25 to 250) lbf·in (250 to 12 000) lbf·in (12 000 to 18 000) lbf·in	0.000 58 lbf·in + 0.55 % 0.0058 lbf·in + 0.85 % 0.069 lbf·in + 0.49 % 0.12 lbf·in + 0.72 %	ISO 6789
Force <sup>3</sup> –  Testing Machines Tension  Compression Testing Machines  Force Gauges <sup>3</sup> – Compression & Tension	  (4 to 100) lbf (100 to 1000) lbf (1000 to 10 000) lbf  (4 to 100) lbf (100 to 1000) lbf (1000 to 10 000) lbf (10 000 to 100 000) lbf (100 000 to 500 000) lbf  Up to 100 lbf (100 to 30 000) lbf	  1.2R + 0.74 % 1.2R + 0.59 % 1.2R + 0.22 %  1.2R + 0.74 % 1.2R + 0.59 % 1.2R + 0.22 % 1.2R + 0.57 % 58 lbf + 0.57 %  0.82R + 0.01 % 0.82R + 0.053 %	  ASTM E4-16 ASTM E74-18 with standard load cells        Weight standards
Pressure & Vacuum <sup>3</sup> – Measuring Equipment  Pneumatic          Hydraulic  Pneumatic/Hydraulic  Barometric	  (-14 to 0) psig  (-1 to 1) inH <sub>2</sub> O  (-5 to 5) inH <sub>2</sub> O  (0 to 10) inH <sub>2</sub> O  (10 to 300) mmHg (1 to 300) psig  (0 to 1000) psia  (14.5 to 530) psig (530 to 10 150) psig  (10 150 to 36 000) psig  (60 to 110) kPa	  0.0041 psig  0.0037 inH <sub>2</sub> O  0.0072 inH <sub>2</sub> O + 2.9 µinH <sub>2</sub> O/inH <sub>2</sub> O  0.0035 inH <sub>2</sub> O + 0.091 µinH <sub>2</sub> O/inH <sub>2</sub> O  0.0057 mmHg + 0.064 % 0.00042 psig + 0.024 %  0.009 psia + 0.012 %  0.098 psig + 0.011 % 0.062 psig + 0.022 %  11 psig  0.048 kPa	  EURAMET Guide 17  Vacuum gauge  Digital pressure gauge   Silicon pressure transducer  Dead weight ball gauge  Pressure transducer  Hydraulic dead weight tester  Digital pressure gauge

Parameter/Equipment	Range	CMC <sup>2, 4, 6, 11</sup> (±)	Comments
Mass –  ASTM Classes 1, 2, 3, 4, 5, 6 & 7 OIML Classes E2, F1, F2, M1, M2 & M3	(1 to 10) mg (20 to 500) mg (1 to 5) g 10 g 20 g 50 g 100 g 200 g 500 g 1 kg 2 kg 5 kg 10 kg (20 to 25) kg 500 kg	0.0019 mg 0.0028 mg 0.0086 mg 0.0076 mg 0.013 mg 0.02 mg 0.045 mg 0.07 mg 0.17 mg 0.22 mg 3.8 mg 7.7 mg 40 mg 100 mg 24 g	NIST SOPs 4, 5, 7 & 8  Mass standards, mass comparators, microbalances and analytical balances

VIII. Optical Quantities

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Colorimeters <sup>3</sup> –	(0 to 0.17) mg/L (0.17 to 0.48) mg/L (0.48 to 0.69) mg/L  (0 to 0.25) mg/L (0.25 to 0.97) mg/L (0.97 to 1.68) mg/L  (0 to 0.25) mg/L (0.25 to 1.60) mg/L (1.60 to 2.86) mg/L  (0 to 2.2) mg/L (2.2 to 4.0) mg/L (4.0 to 7.1) mg/L	0.051 mg/L 0.061 mg/L 0.073 mg/L  0.091 mg/L 0.10 mg/L 0.14 mg/L  0.091 mg/L 0.14 mg/L 0.30 mg/L  0.24 mg/L 0.37 mg/L 0.64 mg/L	Ozone (mid-range) color standards.  DPD chlorine LR color standards.  DPD chlorine MR color standards.  DPD chlorine HR color standards

Parameter/Equipment	Range	CMC <sup>2,4</sup> (±)	Comments
Illuminance – Light Meters Visible Spectrum	(4 to 450) fc	0.12 fc + 3.6 %	Reference light meter
Polarimeter <sup>3</sup> – Optical Rotation Wavelength (325 to 633) nm	(10.818 to 46.736) °	0.0065 °	Quartz control plate
Refraction Index <sup>3</sup>	(0 to 15) ° Brix (15 to 40) ° Brix (40 to 97.05) ° Brix	0.026 ° Brix 0.027 ° Brix 0.036 ° Brix	Refractive index calibration standards
Transmittance <sup>3</sup> /Absorbance <sup>3</sup> – Spectrophotometers (250 – 2800) nm	90 % T/0.0362 A 30 % T/0.5229 A 10 % T/1.000 A	0.0022 A 0.0041 A 0.0046 A	Transmission & absorbance glass filter certified reference materials  T = Transmittance in Absorbance units (A)
Wavelength <sup>3</sup> – Spectrophotometers	(240 to 642) nm	0.11 nm	Holmium oxide solution wavelength certified reference material
Aerosol Particle Counter <sup>3</sup> – Counting Efficiency	(0.2 to 1) µm	5.3 %	ISO 21501-4  Comparison against a standard particle counter. Uncertainty counting efficiency derived from the formula stated in 21501-4 Annex E
Particle Size Setting	0.3 µm 0.5 µm 1.0 µm 5.0 µm 10.0 µm	0.018 µm 0.012 µm 0.016 µm 0.075 µm 0.1 µm	Uncertainty of size setting error derived from the formula stated in ISO 21501-4 Annex E

IX. Thermodynamics

Parameter/Equipment	Range	CMC <sup>2, 4, 6</sup> (±)	Comments
Temperature <sup>3</sup> – Measuring Equipment  Digital & Mechanical Thermometers & Temperature Probes	(-200 to -40) °C (-40 to 0) °C (0 to 232) °C (232 to 420) °C (420 to 660) °C (660 to 1 200) °C	0.028 °C 0.026 °C 0.048 °C 0.070 °C 0.081 °C 3.5 °C	Digital indicator with PRT, liquid baths, dry blocks  Dry block calibrator
Temperature <sup>3</sup> – Measuring Equipment  Ambient Equipment  Thermocouples	(-40 to 100) °C (10 to 50) °C (50 to 200) °C  (-80 to -40) °C (-40 to 0) °C (0 to 650) °C (650 to 1200) °C	0.059 °C 0.056 °C 0.059 °C  0.3 °C 0.54 °C 0.38 °C 1.6 °C	Digital indicator with PRT
Temperature – Dry Blocks	(-80 to 0) °C (0 to 232) °C (232 to 420) °C (420 to 660) °C (660 to 1200) °C	0.062 °C 0.071 °C 0.19 °C 0.20 °C 0.25 °C + 0.36 %	Digital indicator with PRT
Temperature <sup>3</sup> – Liquid-in-Glass Thermometers	(-80 to 105) °C (95 to 205) °C (195 to 405) °C	0.084 °C 0.11 °C 0.14 °C	Digital indicator with PRT
Temperature <sup>3</sup> – Measure  Temperature Chambers, Ovens, Freezers	(-200 to 0) °C (0 to 232) °C (232 to 420) °C (420 to 660) °C  (660 to 1200) °C	0.055 °C 0.067 °C 0.08 °C 0.18 °C  4.7 °C + 0.56 %	Digital indicator with PRT  Digital indicator with thermocouple

Parameter/Equipment	Range	CMC <sup>2,4,6</sup> (±)	Comments
Infrared Temperature Thermometer <sup>3</sup>	(-15 to 0) °C (0 to 100) °C (100 to 200) °C (200 to 500) °C	0.55 °C 0.35 °C 0.96 °C 2.1 °C	Black body IR calibrators
Relative Humidity <sup>3</sup> – Measuring Equipment	(0.25 to 10) % RH (10 to 35) % RH (35 to 80) % RH (80 to 95) % RH	0.97 % RH 0.99 % RH 1.1 % RH 1.1 % RH	Hygrometer standard, humidity generator
Relative Humidity <sup>3</sup> – Measure & Environmental Testing	(0.25 to 10) % RH (10 to 35) % RH (35 to 80) % RH (80 to 95) % RH	0.97 % RH 0.99 % RH 1.1 % RH 1.1 % RH	EURAMET GUIDE NO.: 20 & IEC 60068-3
Dew Point <sup>3</sup> – Measuring Equipment	(-80 to -60) °F (-60 to -30) °F (-30 to -20) °F (-20 to 0) °F	4.4 °F 4.4 °F 6.6 °F 3 °F	Dew point transmitter
At 1 Bar	(-10 to 60) °C	0.83 °C	Calculated using temperature & humidity standards.

#### X. Time & Frequency

Parameter/Equipment	Range	CMC <sup>2,6</sup> (±)	Comments
Frequency <sup>3</sup> – Measure	(0 to 300) MHz	0.34 μHz/Hz	Frequency counter
Frequency <sup>3</sup> – Measuring Equipment	Up to 600 MHz	3.1 μHz/Hz	Multifunction calibrator with frequency counter

Parameter/Equipment	Range	CMC <sup>2,6</sup> ( $\pm$ )	Comments
Time <sup>3</sup> – Measure  Stopwatch & Timing Device	Up to 86 400 s	27 ms + 0.045 $\mu$ s/s	Frequency counter, frequency generator  NIST SP-960-12



## MECHANICAL TESTING

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory<sup>12</sup> to perform the following test on fume hoods, bio-safety cabinets, HEPA filter.

<b>Test:</b>	<b>Test Methods:</b>
BioSafety Cabinets, Class II, Type A1, A2, B1 and B2	NSF/ANSI 49 Annex 5 except 5.7 (site installation assessment) and 5.8 (electrical leakage and ground circuit resistance and polarity)
Laboratory Fume Hood (as installed, as used)	ASHRAE 110
Cleanrooms & Associated Controlled environments – Test Methods	ISO 14644-3 at Annex B.8.2.2 photometer method

<sup>1</sup> This laboratory offers commercial calibration service and field calibration service.

<sup>2</sup> Calibration and Measurement Capability Uncertainty (CMC) is the smallest uncertainty of measurement that a laboratory can achieve within its scope of accreditation when performing more or less routine calibrations of nearly ideal measurement standards or nearly ideal measuring equipment. CMCs represent expanded uncertainties expressed at approximately the 95 % level of confidence, usually using a coverage factor of  $k = 2$ . The actual measurement uncertainty of a specific calibration performed by the laboratory may be greater than the CMC due to the behavior of the customer's device and to influences from the circumstances of the specific calibration.

<sup>3</sup> Field calibration service is available for this calibration. Please note the actual measurement uncertainties achievable on a customer's site can normally be expected to be larger than the CMC found on the A2LA Scope. Allowance must be made for aspects such as the environment at the place of calibration and for other possible adverse effects such as those caused by transportation of the calibration equipment. The usual allowance for the actual uncertainty introduced by the item being calibrated, (e.g., resolution) must also be considered and this, on its own, could result in the actual measurement uncertainty achievable on a customer's site being larger than the CMC.

<sup>4</sup> In the statement of CMC, percentage indicates percent of reading, unless otherwise noted.

<sup>5</sup> The stated measured values are determined using the indicated instrument (see Comments). This capability is suitable for the calibration of the devices intended to measure or generate the measured value in the ranges indicated. CMCs are expressed as either a specific value that covers the full range or as a percent or fraction of the reading plus a fixed floor specification.

<sup>6</sup> The type of instrument or material being calibrated is defined by the parameter. This indicates the laboratory is capable of calibrating instruments that measure or generate the values in the ranges indicated for the listed measurement parameter.

<sup>7</sup> This scope meets A2LA's P112 Flexible Scope Policy.





- <sup>8</sup> This accreditation includes those field service representatives located in the Dominican Republic and Costa Rica at Av 61, La Guaria, San José, San Vicente reporting to Phoenix Calibration, Santo Domingo, Dominican Republic.
- <sup>9</sup> This laboratory meets R205 – Specific Requirements: Calibration Laboratory Accreditation Program for the types of dimensional tests listed above and is considered equivalent to that of a calibration.
- <sup>10</sup> In the statement of CMC,  $R$  is the resolution of the unit under calibration,  $L$  is the numerical value of the nominal length of the device measured in inches or millimeters,  $D$  is the numerical value of the nominal diameter of the device measured in inches or millimeters.
- <sup>11</sup> The contributions from the repeatability of the device under calibration are not included in the CMC claim.
- <sup>12</sup> Accreditation is granted for field testing activities at this location only, and only applies to field technicians that are based out of this location.





# Accredited Laboratory

A2LA has accredited

## PHOENIX CALIBRATION

*Santo Domingo, DOMINICAN REPUBLIC*

for technical competence in the field of

### Calibration

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 *General requirements for the competence of testing and calibration laboratories*. This laboratory also meets the requirements of R205 – Specific Requirements: Calibration Laboratory Accreditation Program. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).



Presented this 9<sup>th</sup> day of March 2023.

A handwritten signature in blue ink, appearing to read "Trace McInturff".

Mr. Trace McInturff, Vice President, Accreditation Services  
For the Accreditation Council  
Certificate Number 3022.01  
Valid to January 31, 2025  
Revised October 28, 2024

*For the calibrations to which this accreditation applies, please refer to the laboratory's Calibration Scope of Accreditation.*